TC-permitting GCM simulations of hurricane frequency response to sea surface temperature anomalies projected for the late 21st century

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Abstract. A tropical cyclone permitting global climate model is used to explore hurricane frequency response to sea surface temperature (SST) anomalies generated by coupled models for the late 21st century using the IPCC AR4 A1B scenario. Results are presented for SST anomalies computed by averaging over 18 CMIP3 models as well as from individual realizations from 8 different models. For each individual ocean basin, there generally exists large inter-model spread in the magnitude and (for a few basins) even the sign of the response in hurricane frequency to warming among the different SST projections. These sizable variations in response are explored to understand features of SST distributions that are important for storm genesis in individual basins. In the N. Atlantic, the E. Pacific and the S. Indian basins, most (72-86%) of the inter-model variance in storm frequency response can be explained by a simple relative SST index defined as a basin's storm development region SST minus the tropical mean SST. The explained variance is significantly lower in the S. Pacific (48%) and much lower in the W. Pacific basin (27%). When the W. Pacific is separated into 3 sub-basins, 42% of the inter-model variance in the main development region can still be accounted for by the simple relative SST index while storms in South China Sea and the Eastern W. Pacific correlate to SSTs in the Central and Eastern Pacific.

Six atmospheric parameters are utilized to probe changes in tropical atmospheric circulation and thermodynamical properties relevant to storm genesis. While all present strong correlation to storm frequency response in three basins, one parameter measuring the large-scale tropospheric convective activity stands out as a skillful variable in explaining the simulated differences for all basins. Globally, in addition to a modest reduction of total storm frequency, the simulations exhibit a small but robust eastward and poleward migration of genesis frequency in both the N. Pacific and the N. Atlantic oceans upon warming. This eastward migration of storms can also be explained by changes in large-scale convective activities. The implication on the role of convection in controlling regional and global tropical

cyclone frequency response to 21st century warming is discussed.